according to the utilitarian or the intuitive theory of morality.

Such vagaries as the above are however rare, and we can conscientiously recommend this book as admirably adapted to lead its readers to observe for themselves the varied phenomena presented by insects, and thus to become true entomologists. ALFRED R. WALLACE

AMERICAN GEOLOGY

Preliminary Field Report of the United States Geological Survey of Colorado and New Mexico. Conducted under the authority of the Hon. J. D. Cox, Secretary of the Interior. By F. V. Hayden, United States Geologist. 8vo. pp. 155. (Washington: Government Printing Office, 1869.)

THIS preliminary field report makes us acquainted with a vast tract of territory hitherto scarcely known, save to the more adventurous squatters and to the various tribes of Indians who have gradually been driven farther and farther west by the wonderful growth of the United States populations, fed as they are annually by streams of English, Irish, Scotch, and German emigrants. Unfortunately for the Red-skins, they are not only hemmed in on the one side by the United States, and on the other by the equally vigorous growth of California and its vast mining and agricultural population; but their territory, only hitherto invaded by the Mormons and the "Pony-Dispatch," is now cut in twain by the great Pacific Railroad, which, in its course, has sent forth geological reconnaissances right and left, discovering timber here, coal there, building stone in this spot, mines in that, until there is no space left for them save in the happy hunting-grounds above, to which they are fast going, aided by revolvers, alcohol, and disease.

The report refers to a line of country extending from British North America to New Mexico in a northerly and southerly direction, and from the Rocky Mountains to the Lower Missouri in an easterly and westerly one. Dr. Hayden explains the reason why he has been able in a very short time to cover so large a tract of territory—it is, that "there is great uniformity in the geology of the country, and when one has become familiar with the different geological formations over a small area, he can trace them with great rapidity over long distances" (p. 11).

First, we have the Rocky Mountain system forming the main ridges and the hills, composed of granite rocks. Resting on the flanks of these more elevated masses, the stratified deposits are exposed in succession, becoming less and less inclined as we recede from them and enter the plains.

The oldest stratified deposit met with is the Potsdam Sandstone, equivalent in geological position to our Upper Cambrian, or to the Primordial Zone of Barrande; this is followed by strata of Carboniferous age, but giving no promise of workable seams of coal. The Triassic series may be represented by certain red arenaceous deposits, sometimes containing gypsum and rocksalt; these pass upwards into undoubted Oolitic beds. Next follows a Cretaceous formation, some 4,000 feet in thickness, followed by a well-developed Tertiary series of vast geographical extent, and but very slightly inclined.

These Tertiary beds are rich in lignites, and evidence a long period of tranquil estuarine or lacustrine deposition in a region supporting dense forests of large trees, and a vegetation far exceeding in luxuriance anything now met with in these latitudes. Carnivores, Pachyderms, Proboscidea, &c., occur in great abundance. It is very interesting to know that in Tertiary times North America had its elephants, hippopotami, rhinoceroses, horses, lions, &c., and was, in the size and abundance of its Mammalia, in no way surpassed by the Continents of the Old World.

Two minor reports accompany Dr. F. V. Hayden's report, one on "Mines and Mining," by Mr. Persifor Frazer, jun., giving a most interesting account of the mining capabilities of the district; the other on the "Agriculture of Colorado," by Mr. Cyrus Thomas. There is every prospect of the Colorado territory becoming as rich an agricultural district as it has already proved to be a mining one. H. W.

OUR BOOK SHELF

Aunt Rachel's Letters about Water and Air. (London: Longmans and Co., 1871.)

IN the form of a series of familiar letters from an aunt to a nephew and niece, we have here an account, in simple familiar language, of some of the commoner physical phenomena of nature. Recollecting the books with a similar aim that have passed through our hands, we feel grateful to find one free from conspicuous blunders. To the little book before us we need not however apply such negative praise. It is in all respects to be commended as a book to put into the hands of the young. And we fancy that even many well-educated people who are not young in years, will find a record and explanation of facts with which they are not familiar. They may learn here all about the formation of ice, latent and specific heat, the air-pump, the barometer and thermometer, the winds, combustion, and many other phenomena of daily life. A few well-executed woodcuts illustrate the text; and we would like to hear that a large circulation has rewarded the efforts of "Aunt Rachel" to popularise the elements of science.

Handbuch der allgemeinen Himmelsbeschreibung vom Standpunkte der kosmischen Weltanschauung dargestellt. Von Hermann J. Klein. Pp. 351. (Braunschweig, 1871. London: William and Norgate.)

Theoretische Astronomie. Von Dr. W. Klinkerfues. Erste Abtheilung. Pp. 256. (Ditto, ditto.)

THE first of these works is the second edition of the first part of a general description of the universe, and is devoted to the solar system: another part will be given to the fixed stars. The aim of the author is to afford a complete account of his subject, including the latest researches, which shall be at the same time thoroughly scientific, while it will not be beyond the comprehension of those who are possessed of only an elementary knowledge of astronomy, or more properly perhaps uranography. The first forty-nine pages contain a description of the sun; the next five are given to the zodiac. Then follow the planets Mercury, Venus, &c., in order, and finally we have a full and very interesting account of comets and meteorites.

Turning to the chapter on the sun, we find, after a general introduction, methods for calculating the distance between the centre of the sun and that of the earth. After this we have an account of the "spots," accompanied with tables of their numbers in different years, and their connection with the movements of the magnetic needle. The labours of Herschel, Airy, Lockyer, Huggins, and others are largely quoted, and the author begs any ob-

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server whose researches may have been omitted, to attribute the neglect to the disturbing influence of recent events. The earth and her satellite are treated at some length, and the questions of the moon's influence on the earth's atmosphere, the winds, weather, and magnets, are fully discussed. The chapter on meteorites is very interesting. We are told, on the authority of Miller and Haidinger, that the earliest mention of meteorites is probably in Iliad xv. 18—22, where the anvils spoken of by Jupiter are supposed to refer to these phenomena. Livy mentions a shower which some think may have been a star shower; and the famous black stone in the Kaaba, at Mecca, is said to be undoubtedly a meteorite of great antiquity. Numerous analyses of meteorites are given, and tables are added containing full details of all those which are recorded to have fallen from the earliest times. There are similar tables with regard to comets and star-showers; and finally we have two well-executed plates of the appearance of different sun-spots, and a chart of part of the moon's surface. We should like to see an English edition.

The Theoretical Astronomy of Dr. Klinkerfues, director of the Royal Observatory of Göttingen, is a reproduction of lectures delivered by him in that University. This is the first part of the work, and its object is to give an explanation of the means by which the courses and positions of heavenly bodies are determined. It is not adapted to the general reader, but will prove a useful companion to the mathematician who wishes to obtain an insight into astronomical methods of calculation. Several very good figures accompany the text.

G. T. A.

Kuklos; an Experimental Investigation into the Relationship of Certain Lines. By John Harris Part I. (Montreal, 1870)

IN a review of Prof. Bretschneider's History of Early Geometry we have mentioned some clever attempts to square a circle, made at a time when this problem engaged the attention of the first mathematicians. Then, however, as at present, there existed circle squarers of a different kind, who excel only in demonstrating their own ignorance. A fine specimen is preserved by Simplikios. Some persons had heard of square numbers which are at the same time cyclical, that is to say, the last figure in the square number is the same as that of the root, as 25 and 5. Nothing, of course, could be more evident to them than that a number which is both square and cyclos must be a measure for the circle. Mr. Harris ranks almost as high, only he does not give his conclusions in quite so short a form. His book is to consist of four parts in quarto, of which the first contains merely a preface, preliminary arguments, and on the last page an introduction. In the preface the author excuses the haste in which the publication has taken place, with the remark that if his researches are of value they cannot be brought early enough before the public,—if a failure "the communication itself would not be worth the additional labour bestowed on improving its form." This latter conclusion we willingly grant. It is only to be regretted that Mr. Harris has not had the same opinion of the time he spent in writing this communication and preparing the numerous and long figures which fill ten large plates.

LETTERS TO THE EDITOR

[*The Editor does not hold himself responsible for opinions expressed by his Correspondents. No notice is taken of anonymous communications.*]

Pangenesis

MR. GALTON—by acting upon the conclusion that the supposed gemmules supposed to be detached from the cells of the body at different periods of life in the case of the higher animals swarmed in the blood prior to their supposed collection and union to form the reproductive element—favoured the provisional hypothesis of Pangenesis, for he indicated a not improbable manner in which the very improbable phenomena involved in the hypothesis might actually occur.

But Mr. Darwin, in NATURE for April 27th, writes to explain that he maintains that the gemmules must be "thoroughly diffused"—I conclude, suspended in the fluids which circulate freely in every part of the very substance of all the tissues of the body. The supposed gemmules must be much more minute than the smallest particles that can be seen by the highest magnifying powers used in these days, and must be invisible to the eye when made to appear five thousand times larger than their real size. They must be capable of *diffusion*, and, as is suggested by Mr. Darwin, much as chemical substances are *diffused*.* But the terms of the hypothesis would imply that the gemmules are actual particles *suspended* and not *dissolved* in the fluids.

It is not very encouraging to those who work, to discover after having performed numerous and well-devised series of difficult, laborious, and troublesome experiments honestly to test the value of a hypothesis, that they have been investigating a shadow, and to be then informed that the results they have obtained have little or no bearing on the question at issue. The "experiments are extremely curious," says Mr. Darwin, and the experimenter "deserves the highest credit for his ingenuity and perseverance."

It would, of course, be possible to remove from one animal portions of tissue which, according to the hypothesis, *must* contain the supposed gemmules, if they exist, and graft the pieces of tissue upon another. If the experiment was successful, and the offspring exhibited any of the characters of the variety from which the graft was taken, the opponents of Pangenesis would admit the doctrine at once, but if the results were again of a negative kind, would Mr. Darwin consider that his hypothesis had "received its death blow?" It would certainly be as easy to defend it as it is at this time. Nor do I believe it possible to obtain a series of experimental results which would lead the supporters of Pangenesis to abandon the hypothesis. A firm belief in hypothetical gemmules, which cannot be rendered evident to the senses, is not likely to be shaken.

Depend upon it, neither the well-devised experiments of Mr. Galton, nor any other experiments that may be devised, will overthrow this doctrine. The provisional hypothesis of pangenesis is perfectly safe, and will withstand every attack that may be made. It cannot be successfully assailed. Like many favoured hypotheses of these days, it can neither be proved to be true nor positively shown to be false, and it is open to anyone to ground his belief in the truth of this and other doctrines upon the fact that they have not been and cannot be disproved. For undoubtedly gemmules *may* be formed in the manner supposed; if formed, they *may* be detached; if detached, they *may* pass through the tissues; they *may* then collect together, and *may* form reproductive elements. Each one of the countless millions of sperm elements produced in such profusion during so many years of life *may*, indeed, be formed by the union of millions of gemmules which, after meandering through the various textures of the body, marshal themselves in order in one particular locality. From the vast company thus supposed to have collected, we *may* conceive, by the light of imagination, the formation of regiments composed of multitudes of individual gemmules of the same kind; and further, it is not difficult to imagine that each individual gemmule of every regiment *may* move away and unite with thousands and tens of thousands of others, to form at length that marvellous compound and complex speck of matter less than the $\frac{1}{50000}$ of an inch in diameter, which constitutes the active material of each small reproductive particle. This is one way in which the properties of the spermatozöon may be accounted for. Nor is it beyond the power of the imagination to picture the orderly arrangement and rearrangement of such vast hosts of potential molecules as is supposed. No confusion, no jostling of one another, no struggling would be seen, for each molecule takes its appointed place, in obedience to its own properties, knowing of course the position it is to occupy in the complex ranks at each different period of its life's progress, and, never ambitious of discharging a higher function than that which it is destined to fulfil, performs the important office of transmitting certain peculiarities, important or trivial, useful or useless, from the existing to a new being.

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* In NATURE for May 1st, Mr Francis Galton very properly remarks that the term Mr. Darwin should have employed is "dispersion" not "diffusion," and there are other critical remarks which appear to me equally just.

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